

**Genetic variability for yield, its components and quality traits in upland cotton (*Gossypium hirsutum* L.)**

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**Abstract:** The study was carried out at Ayub Agricultural Research Institute Faisalabad Pakistan during 2012 to evaluate twelve cotton genotypes for the development of high yielding cotton varieties. The genotypes were sown in completely randomized block design with three replications. Data was recorded for various quantitative traits and analyzed to access genetic variability among genotypes. It was found that the boll size of FH-207 (1) and FH-207 (22) was large, tapering shape, good opening and leaf was of broad size as compared to all other varieties. Higher values of heritability and genetic advance were recorded for first bud days (98.186%, 126.640%), sympodial branches (53.846%, 63.992%), monopodial branches (99.392%, 51.475%), number of bolls (95.937%, 181.233%), plant height (94.233%, 151.062%), boll weight (89.912, 23.485%), GOT% (56.938%, 39.959%) and fibre strength (66.545%, 51.332%) respectively. Significant correlations were found for boll weight, number of bolls, staple length, fibre strength and fibre fineness. From prescribed study it was concluded that higher heritability indicated that selection for hybrid cotton may be helpful to improve yield and quality of cotton while genetic advance suggested that selection for synthetic variety may be fruitful and significant correlation among traits suggested that selection may be useful for the enhancement of yield and quality of cotton.

[Hafiz Ghazanfar Abbas, Abid Mahmood, Qurban Ali, Saif-ul-Malook, Muhammad Waseem and Nazar, Hussain Khan. **Genetic variability for yield, its components and quality traits in upland cotton (*Gossypium hirsutum* L.).** *Nat Sci* 2014;12(11):31-35]. (ISSN: 1545-0740). <http://www.sciencepub.net/nature>. 5

**Keywords:** heritability, genetic advance, correlation, *Gossypium hirsutum*

**Introduction**

Cotton plays a vital role in the whole economy of Pakistan. It is an important industrial, fiber and cash crop. It is grown over 12% of the total cultivated area of Pakistan. Cotton contributes about 60% in the shape of raw cotton and its byproducts in the total economy of Pakistan. In count to its textile industry uses, edible oil and animal feed are also obtained from cotton seed cake. There is about 60-70% of edible oil obtained from cotton (Khan, N.U. 2003). In Pakistan it was grown over an area of 2835 thousand hectares with a production of 13595 thousand bales and an average yield of 815 kg ha<sup>-1</sup> (Anonymous (2011-12). The production of seed cotton of Pakistan is considered as low if compared to other cotton growing countries like India, China, USA, Mexico and Australia. The seed cotton yield as a complex trait, is the product of relationship among its components fixed with unstable environmental conditions. The correlation among the various yielding traits may be helpful to improve the seed cotton yield. The correlation analysis reflects the retort of a specific trait with its analogous trait and it also provides an excellent index to predict the corresponding change which occurs in one trait due to the change in the

other traits. Khan *et al.*, 2007; Meena *et al.*, 2007; Suinaga *et al.*, 2006; Taohua and Haipeng 2006 and Farooq *et al.*, [11] reported strength and adaptability of cotton genotypes and found varied values for different morphological, agronomic and yielding traits. Iqbal *et al.*, [12]; Wang *et al.* 2004; Farooq *et al.*, 20013 and saif-ul-malook *et al.*, 2014abc reported genetic variability with positive correlation among seed cotton yield and contributing yielding traits in upland cotton. The present study was conducted to evaluate genetic variability cotton genotypes for staple length, fibre strength, fibre fineness and their related traits of cotton.

**Materials and Methods**

The study was carried out at Cotton Research Institute, Ayub Agricultural Research Institute Faisalabad Pakistan during 2012. The germplasm comprised of FH-207 (1), FH-207 (22), FH-207 (28) (YP), Bt-63 (88), Bt-79, Sbne-259m, Fh4243 P1-4, Fh4243Spp32 (okra), Fh941Spp33, FH-941spp-46, FH-2015BP-10 and FH-2015BP-10. All of the twelve genotypes were sown in three replications following complete randomized block design with plant to plant distance 30cm and row to row 75cm in plot of size

4×4 meter. All agronomic practices were kept same in all of the three replications and data of 10 plants from each replication of each genotype was recorded for monopodial branches, sympodial branches, nodes to first flower days, first bud day, boll weight, number of bolls, staple length, fibre strength, GOT%, fibre fineness and plant height, boll size, maturity, boll shape, boll opening and leaf size. The data was subjected for analysis of variance (Steel *et al.*, 1997). The genotypic correlations were calculated by Kwon and Torrie (1964) technique through Minitab 16.1 software. The genetic advance was calculated by using Falconer formula (1989).

### Results and discussions

It is cleared from Table 2 and Table 4 that significant differences were found for all traits for all of twelve genotypes. Higher genotypic and phenotypic variance and coefficient of variance was recorded for first bud days, plant height, number of bolls, boll weight, fibre strength and sympodial branches [Abbas *et al.*, 2013; Amir *et al.*, 2012; Iqbal, *et al.*, 2003; Amin, *et al.*, 2014ab and Ali *et al.*, 2011]. Higher values of heritability and genetic advance were recorded for first bud days (98.186%, 126.640%), sympodial branches (53.846%, 63.992%), monopodial branches (99.392%, 51.475%), number of bolls (95.937%, 181.233%), plant height (94.233%, 151.062%), boll weight (89.912, 23.485%), GOT% (56.938%, 39.959%) and fibre strength (66.545%, 51.332%) respectively. It was found that higher environmental variance and coefficient of variance was recorded for sympodial branches, plant height, nodes to first flower days and fibre strength. Higher heritability showed dominance type of gene action and genetic advance showed additive type of gene action indicated that selection of higher yielding cotton genotypes may be helpful to improve cotton seed yield and quality through developing hybrids while using higher heritability and synthetic varieties by using additive types of gene action (Ali *et al.*, 2011). The boll size of FH-207 (1), FH-207 (22) and Sbne-259m was large, tapering shape, good opening and leaf was of broad size as compared to all other varieties (Table 1). The mean significant differences are given in table 4 and also it is clear from Fig. 1 that Fh941Spp33 and Fh4243Spp32 (Okra) showed higher values for first bud days, nodes to first flower days and sympodial branches while Fh-207 (28) (YP) and Bt-63 (88) showed higher monopodial branches. It is persuaded from Fig. 2 that Sbne-259m, Fh-207 (28) (YP), FH-2015BP10 and FH-207 (22) showed higher values of plant height, number of bolls, GOT% and boll weight respectively. FH-207 (22) and Fh4243Spp32 (Okra) showed higher values of fibre strength, staple length and fibre fineness (Fig. 3).

Better average performance of genotypes for various traits suggested that the genotypes with higher number of bolls, boll weight, fibre strength, fibre fineness, monopodial branches per plant and GOT% can be selected for improving the cotton seed yield and quality (Abbas *et al.*, 2013; Saif-ul-malook *et al.*, 2014d; Ali *et al.*, 2013ab). It was suggested from table 3 that higher and significant correlation was found for node to first day flower with number of monopodial branches, number of bolls per plant and fibre strength while negatively correlated with first buds days. A significant and positive correlation of monopodial branches was found with sympodial branches, number of bolls, plant height, node to first flower, GOT% and boll weight while negatively correlated with first bud days and staple length (Taohua, *et al.*, 2006; Meena, *et al.*, 2007; Batool, *et al.*, 2010 and Farooq *et al.*, 2013). Sympodial branches were significantly correlated with monopodial branches, number of bolls, plant height, staple length and boll weight while negatively correlated with GOT%, first bud days and fibre fineness. Number of bolls was significantly correlated with first bud days, sympodial branches, node to first day flower, monopodial branches and GOT% while negatively correlated with boll weight, staple length and fibre strength. Higher number of monopodial branches per plant may be used to improve number of bolls per plant which may be helpful to improve cotton yield and quality (Ahsan *et al.*, 2013). Plant height was significantly correlated with sympodial branches, monopodial branches, number of bolls, staple length and fibre fineness while negatively correlated with fibre strength. Boll weight was significantly correlated with sympodial branches, monopodial branches, plant height, fibre strength, staple length, fibre fineness and boll weight while negatively correlated with number of bolls, first bud days and GOT%. GOT% was positively and significantly correlated with monopodial branches, fibre fineness and number of boll while negatively correlated with sympodial branches, fibre strength and staple length. Significant correlation between monopodial branches per plant and fibre fineness suggested that cotton quality may be improved by selecting on the basis of monopodial branches per plant (Khan, 2013; Suinaga, *et al.*, 2006 and Wang, *et al.*, 2004). Staple length was positively and significantly correlated with sympodial branches, first bud days, plant height and boll weight while negatively correlated with monopodial branches, number of bolls and GOT%. Fibre fineness was positively and significantly correlated with plant height, GOT%, fibre strength and boll weight while negatively correlated with sympodial branches. Fibre strength was positively and significantly correlated with number of nodes to first day flower, fibre

fineness and boll weight while negatively correlated with plant height, number of bolls, first bud days and GOT%. Higher boll weight suggested that fibre fineness and yield may be increased on the basis of

selecting genotypes for better cotton yield and production Ali, *et al.*, 2011b; Amir, *et al.*, 2012; Steel, *et al.*, 1997 and Wang, *et al.*, 2004.

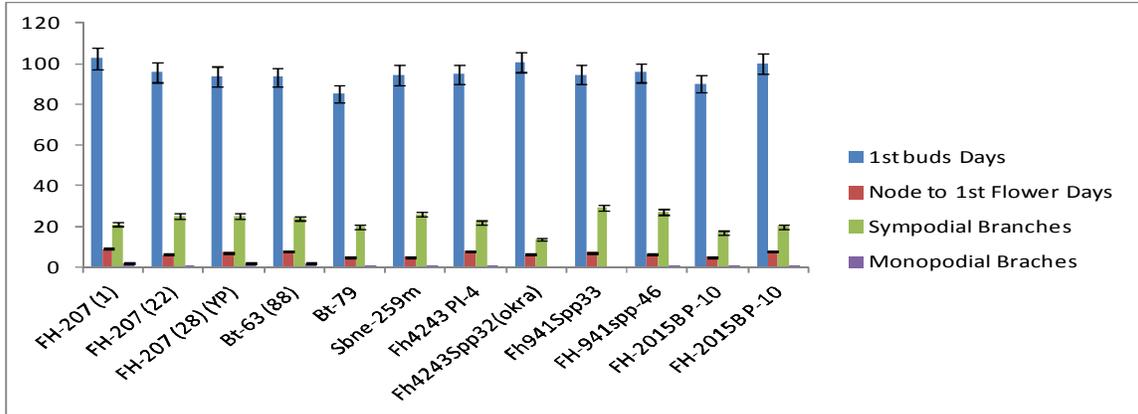


Figure 1. Mean performance of cotton genotypes for First bud days, nodes to first flower days, sympodial branches, monopodial branches

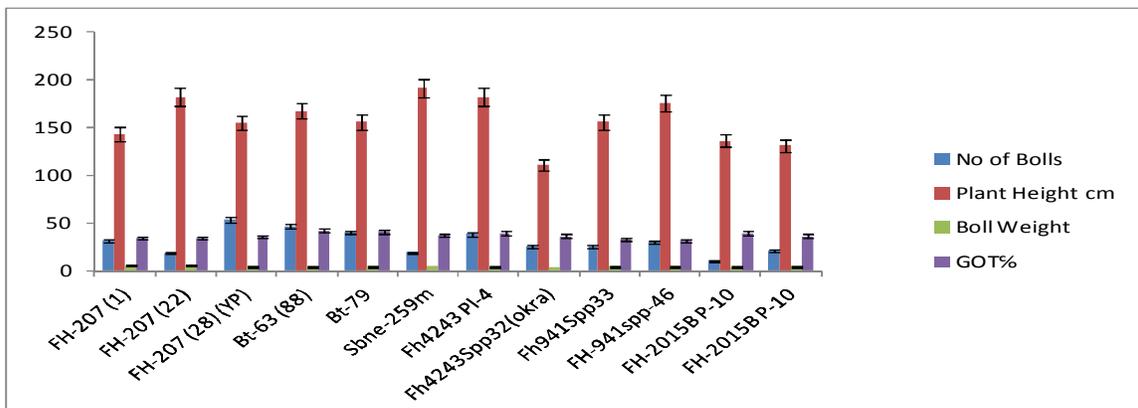


Figure 2. Mean performance of cotton genotypes for Number of bolls, plant height, boll weight, GOT%

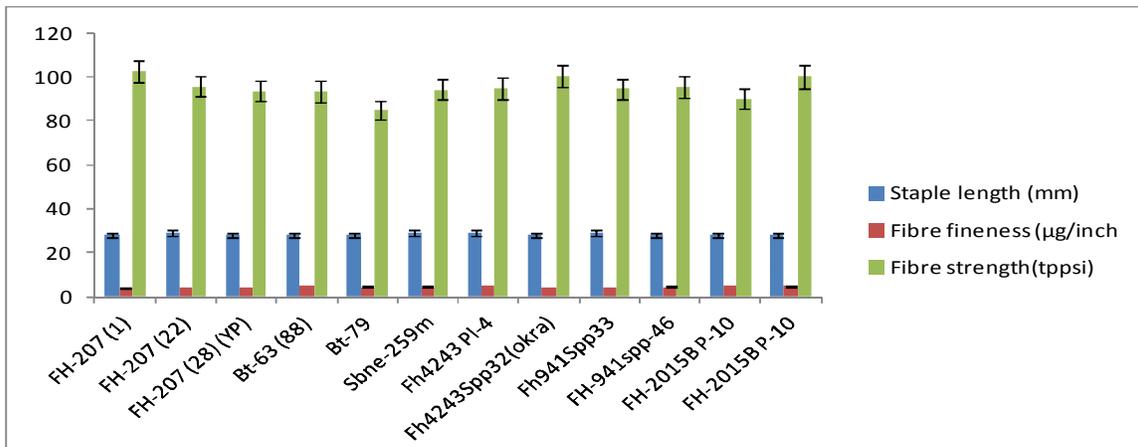


Figure 3. Mean performance of cotton genotypes for Staple length, fibre fineness, fibre strength

**Table 1: Grading traits of cotton varieties**

ENTRIES	Boll size	Boll shape	Boll opening	Maturity	Leaf size
FH-207 (1)	large	tapering	good	early	broad
FH-207 (22)	large	tapering	good	early	broad
FH-207 (28) (YP)	large	round to oval	good	medium	medium
Bt-63 (88)	medium	tapering	good	medium	small
Bt-79	medium	oval	very good	early	small to medium
Sbne-259m	large	round to oval	good	early	broad
Fh4243 Pl-4	medium	round	good	early	broad
Fh4243Spp32(okra)	medium	round	good	medium	narrow
Fh941Spp33	small to medium	round	good	medium	small to medium
FH-941spp-46	medium	round to oval	good	early	broad
FH-2015B P-10	medium	oval	good	early	small to medium
FH-2015B P-10	medium	oval	good	early	small to medium

**Table 2: Genetic components for various yield component traits of cotton**

Traits	Mean sum of square	Grand mean	Genotypic variance	Genotypic coefficient of variance%	Phenotypic variance	Phenotypic coefficient of variance %	Environmental variance	Environmental coefficient of variance %	Heritability h <sup>2</sup> bs%	Genetic advance%
1st Bud Days	81.6888*	29.615	27.063	95.594	27.563	96.473	0.500	12.994	98.186	126.640
Node to 1st Flower Days	4.5**	6.667	0.961	37.969	2.578	62.182	1.617	49.244	37.284	50.300
Symptodial Branches	20.25*	22.500	5.250	48.305	9.750	65.828	4.500	44.721	53.846	63.992
Monopodial Branches	0.49167**	1.083	0.164	38.856	0.165	38.975	0.001	3.038	99.392	51.475
Number of Bolls	168.442*	29.583	55.366	136.804	57.711	139.671	2.345	28.155	95.937	181.233
Plant Height cm	625.242*	157.08	204.247	114.030	216.747	117.467	12.500	28.209	94.233	151.062
Boll Weight	0.40083**	4.098	0.129	17.727	0.143	18.695	0.014	5.938	89.912	23.485
GOT%	12.4167*	36.333	3.306	30.163	5.806	39.973	2.500	26.231	56.938	39.959
Staple length (mm)	0.26667**	28.333	0.089	5.600	0.089	5.603	0.0001	0.188	99.888	7.419
Fibre fineness (µg/inch)	0.11217**	4.533	0.022	7.028	0.067	12.192	0.045	9.963	33.225	9.310
Fibre strength(tppsi)	50*	95.075	14.275	38.748	21.451	47.500	7.176	27.474	66.545	51.332

**Table 3: Correlation among various yield component traits of cotton**

Traits	1st Bud Days	Node to 1st Flower Days	Symptodial Branches	Monopodial Braches	Number of Bolls	Plant Height	Boll Weight	GOT	Staple length	Fibre fineness
Node to 1st Flower Days	-0.254**									
Symptodial Branches	0.1605**	0.0917								
Monopodial Braches	-0.6509*	0.4299*	0.1411**							
Number of Bolls	0.1728**	0.3967*	0.2005**	0.5443*						
Plant Height	-0.0912	-0.1102	0.7451*	0.2331**	0.1474**					
Boll Weight	-0.5786*	0.0497	0.2942**	0.2342**	-0.3227*	0.3518*				
GOT	0.0001	-0.0905	-0.4351*	0.2651**	0.2631**	-0.0059	-0.3667*			
Staple length	0.1768**	-0.0898	0.5108*	-0.3682*	-0.2688**	0.6396*	0.3837*	-0.18**		
Fibre fineness	0.0535	0.0068	-0.1673**	0.0278	-0.0406	0.1142**	0.579*	0.6502*	-0.0189	
Fibre strength(tppsi)	-0.3008*	0.6083*	-0.1151	-0.0167	-0.1948**	-0.3204**	0.3079**	-0.5194*	-0.0236	0.3692*

\* = Significant at 1% level, \*\* = Significant at 5% level

**Table 4. Significant mean differences for various yield components traits of cotton**

1st buds Days	Node to 1st Flower Days	Symptodial Branches	Monopodial Braches	No of Bolls	
Bt-63 (88) 93.410DE	FH-207 (1) 9.0100 A	Fh941Spp33 29.010 A	Bt-63 (88) 2.0100 A	FH-207 (28 53.010 A	
Bt-79 85.110	Bt-63 (88) 8.0100 AB	FH-941spp- 27.010 AB	FH-207 (1) 2.0100 A	Bt-63 (88) 46.010 AB	
FH-2015B P 95.210D	Fh4243 Pl- 8.0100 AB	Sbne-259m 26.010 AB	FH-207 (28 2.0100 A	Bt-79 40.010 BC	
FH-207 (1) 102.61A	FH-207 (28 7.0100 AB	FH-207 (22 25.010 BC	Bt-79 1.0100 B	Fh4243 Pl- 38.010 BC	
FH-207 (22 95.810D	Fh941Spp33 7.0100 AB	FH-207 (28 25.010 BC	FH-207 (22 1.0100 B	FH-207 (1) 31.010 CD	
FH-207 (28 93.710DE	FH-2015B P 6.5100 AB	Bt-63 (88) 24.010 BCD	FH-941spp- 1.0100 B	FH-941spp- 29.010 CDE	
FH-941spp- 95.510D	FH-207 (22 6.0100 AB	Fh4243 Pl- 22.010 CDE	Fh4243 Pl- 1.0100 B	Fh4243Spp3 25.010 DEF	
Fh4243 Pl- 94.910DE	FH-941spp- 6.0100 AB	FH-207 (1) 21.010 DEF	Sbne-259m 1.0100 B	Fh941Spp33 25.010 DEF	
Fh4243Spp3 100.51B	Fh4243Spp3 6.0100 AB	Bt-79 20.010 EF	FH-2015B P 1.0100 B	Sbne-259m 19.010 EF	
Fh941Spp33 94.710DE	Bt-79 5.0100 B	FH-2015B P 18.510 F	Fh4243Spp3 0.0100 C	FH-207 (22 18.010 EF	
Sbne-259m 94.310DE	Sbne-259m 5.0100 B	Fh4243Spp3 14.010 G	Fh941Spp33 0.0100 C	FH-2015B P 15.510 F	
Plant Height cm	Boll Weight	GOT%	Staple length (mm)	Fibre fineness (µg/inch)	Fibre strength(tppsi)
Sbne-259m 191.01A	FH-207 (22 5.3500 A	Bt-63 (88) 42.010 A	FH-207 (22 29.010A	Bt-63 (88) 5.0100 A	Bt-63 (88) 94.430D
FH-207 (22 182.01B	FH-207 (1) 5.1100 B	Bt-79 41.010 A	Fh4243 Pl- 29.010A	Fh4243 Pl- 5.0100 A	Bt-79 86.130E
Fh4243 Pl- 182.01B	Sbne-259m 4.7400 C	Fh4243 Pl- 39.010 AB	Fh941Spp33 29.010A	FH-2015B P 4.8600 A	FH-2015B P 96.230C
FH-941spp- 175.01C	Fh941Spp33 3.9600 D	FH-2015B P 37.510 BC	Sbne-259m 29.010A	Bt-79 4.5100B	FH-207 (1) 103.63A
Bt-63 (88) 167.01D	FH-207 (28 3.9000 D	Sbne-259m 37.010 BCD	Bt-63 (88) 28.010B	FH-941spp- 4.5100B	FH-207 (22 96.830C
Bt-79 156.01E	FH-941spp- 3.8600 D	Fh4243Spp3 36.010 BCD	Bt-79 28.010B	Sbne-259m 4.5100B	FH-207 (28 94.730E
Fh941Spp33 156.01E	FH-2015B P 3.8450 D	FH-207 (28 35.010 CDE	FH-2015B P 28.010B	Fh941Spp33 4.4100BC	FH-941spp- 96.530C
FH-207 (28 155.01E	Bt-79 3.8300 DE	FH-207 (1) 34.010 DEF	FH-207 (1) 28.010B	Fh4243Spp3 4.3100BC	Fh4243 Pl- 95.930D
FH-207 (1) 143.01F	Bt-63 (88) 3.6600 EF	FH-207 (22 34.010 DEF	FH-207 (28 28.010B	FH-207 (22 4.2100BC	Fh4243Spp3 101.53B
FH-2015B P 133.51G	Fh4243 Pl- 3.6400 F	Fh941Spp33 32.010 EF	FH-941spp- 28.010B	FH-207 (28 4.2100BC	Fh941Spp33 95.730D
Fh4243Spp3 111.01H	Fh4243Spp3 3.5600 F	FH-941spp- 31.010 F	Fh4243Spp3 28.010B	FH-207 (1) 4.1100C	Sbne-259m 95.330D

**Conclusions**

It was concluded that genetic variability in cotton for various traits may be used for the development of higher yielding cotton varieties. Higher heritability, genetic advance indicated that selection may be useful for the enhancement of yield and quality of cotton (*Gossypium hirsutum* L.). Significant correlation among sympodial branches, plant height, staple length and GOT% suggested that these traits may be helpful to develop higher yielding cotton genotypes.

#### Authors' contributions

This work was carried out in collaboration between all authors. "Authors QA and HGA" designed the study, QA wrote the first draft of the manuscript. "Authors 'AM' SM, NHK" and "MW" managed the literature search. All authors read and approved the final manuscript."

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9/21/2014